Road Safety Engineering Risk Assessment – Update on Austroads research program

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Abstract:

ARRB are involved in an extensive range of research aimed at identifying the level of risk for different road stereotypes, and at the reduction in this risk resulting from changes in design standards and from remedial treatments. This Austroads funded research is designed to aid policy makers and practitioners in assessing risk and prioritising treatment on their roads. This paper will provide an update on recent research, including:

- database development (collection of data from all Australasian jurisdictions combining crash data, network information and traffic data)
- investigation of risk reduction for various safety treatments in different environments
- the implications for varying design standards on risk
- development of a crash monitoring database for use by all Australasian authorities
- use of crash cost as an indication of severity in different road environments
- indepth investigation of rural head-on and rural intersection crashes
- safety implications of road deterioration
- investigation of crash risk migration

The paper discusses practical use of this information by policy makers and practitioners in the form of the Road Safety Risk Manager software. It also covers proposals for future research in the area of risk reduction, including network based approaches.

1 Introduction

ARRB is undertaking a major Austroads research program to assess risk involving road, traffic and roadside infrastructure. The results will provide all road authorities with more effective tools to reduce road crashes and injuries. The focus for the research has been on proactive assessment of risk rather than reliance on data from existing crash locations, although the results complement, and are of use in the traditional blackspot approach to treating risk.

The initial research program was aimed at developing a basis for prioritising the treatment of deficiencies identified by road safety audits, and led to the release of the Road Safety Risk Manager (RSRM) expert system software program. Ongoing research is aimed at better defining the relationship between road elements and crash risk. This information will be provided to practitioners in a variety of ways, including through a series of newsletters, and future refinements to the RSRM software. The results from the overall research program will:

- improve the understanding of the relationship between crash risk and road elements based on the latest Australasian and world-wide data
- provide practitioners with up to date road safety risk prioritisation methods for different road types and features
- enable state and local authorities to implement more cost-effective road improvement procedures and treatments to reduce road casualties.

This paper summarises progress on the project to the end of June 2005, as well as outlining the research program in the near future.

2 The current research program

The current program consists of a number of inter-related projects relating to road safety engineering risk. These include:

- database development (collection of data from all Australasian jurisdictions combining crash data, network information and traffic data)
- investigation of risk reduction for various safety treatments in different environments
- the implications for varying design standards on risk
- a database for monitoring safety treatment effectiveness
- use of crash cost as an indication of severity in different road environments
- indepth investigation of rural head-on and rural intersection crashes
- safety implications of road deterioration
- investigation of crash risk migration

2.1 Database development

The objective of this component is to collect data from each of the Australasian jurisdictions in order to build crash rate databases, and to use the data in other relevant parts of the project. Crash, traffic, road inventory and monitoring data were requested from each jurisdiction, and where available have been used in appropriate parts of the research. The response from each jurisdiction has varied, but in many cases we are able to determine the level of risk for different road stereotypes.

In addition, a database for literature used for all parts of the project has been produced, and a methodology for the collection of local road data has been developed. Information on local roads crash rates will be calculated in subsequent research.

2.2 Development of risk reduction factors

The purpose for this part of the project was to improve the knowledge of relative risks associated with various engineering issues in different environments, and

to provide more objective analysis methods for use by road authorities in assessing relative risk.

Based on reviews of the relevant literature, relative risk models have been developed or updated for 21 issues. The issues assessed can be found in Table 1:

Table 1 – List of priority issues for further investigation

Issue	
Accesses	Median crossovers
Clear zone – general	Off road delineation - guide posts
Clear zone - length hazard	Overtaking
Clear zone - point hazard	Pavement markings - centreline
Intersection - advanced warning	Pavement markings - edgeline
Intersection - intersection road types	Pedestrian/cyclist
Intersection - red light camera	Signs - advisory
Intersection - right turn phase/lane	Signs - regulatory
Intersection - signal timing	Street lighting
Intersection - signal visibility	Traffic Calming
Intersection - control beacons	

Relative risk models were developed based on the level of crash reduction that could be expected from each measure, although due to lack of robust research evidence, for the majority of models only a medium level of confidence has been applied.

A number of areas where there are current gaps in knowledge were identified, and will be pursued in subsequent research.

2.3 Implications for varying design standards

This component of the project examined the safety implications of varying design standards. A literature review was undertaken to identify the key road design elements and the road safety implications of varying design standards. In addition, separate literature reviews were undertaken on those design elements identified as being important to road safety. From these reviews, a series of models were produced, although due recognition was given to the reliability of the available research results.

In addition, a number of site visits have been made to locations with the same road stereotypes (or geometric site characteristics). Sites with higher than average, average, and lower than average crash rates are being assessed to help determine the influence that design elements play in safety. A data collection methodology has been developed, and site visits continue. Data collected will be processed to identify influencing factors, and if appropriate, models will be developed that identify the effects on safety outcomes of various design issues for intersections and mid-blocks.

2.4 Development of a crash monitoring database

This part of the project seeks to develop a method of tracking the effect of various engineering treatments that are applied to the road network. Better knowledge of the success, or otherwise, of various treatments will provide valuable information for practitioners. A survey of authorities, including State Road Authorities, Transit New Zealand and a sample of local authorities was undertaken to assess what monitoring data is currently collected, what benefit a combined database would bring, and whether authorities would be willing to contribute to this. There was mixed support for such a database, although the majority of respondents thought such a database would be beneficial. Work continues on the best format for such a database, and it is likely that given the current collection of treatment data by State Road Authorities, work in the near future will concentrate on local road measures.

2.5 Use of crash costs as an indication of severity

This part of the project aims to improve the relevance and accuracy of the use of crash costs as proxy measures of crash severity. We now have emerging results of a review of crash costs used by Australasian jurisdictions, as well initial identification of crash types most commonly associated with various situations (for instance differing speed environments). Work carried out to date indicates that data and methodology prerequisites for the development of improved and more detailed crash costing exist, and there is potential for harmonising calculation methods across agencies.

2.6 Rural head-on, and rural intersection crashes

These parts explore the incidence, causes and countermeasures of rural head-on crashes, and rural intersection crashes. A literature review on causes and possible countermeasures for each of these crash types has been conducted. These reviews also assess the level of crash reduction that could be expected from each of these measures. An assessment of crash causes has also been undertaken based on an extensive analysis of crash data from each Australasian jurisdiction. Finally, site visits have been undertaken at a number of locations throughout Australasia where there is a high incidence of these crashes. Characteristics from these sites are being assessed to determine factors that might contribute to the incidence of these crash types.

2.7 Safety implications of road deterioration

The objective of this part of the project is to provide guidance to road safety managers about the risk associated with sub-standard assets and the risk-reduction benefits associated with their restoration, so that safety investments involving the restoration of asset condition can be considered on the same basis as other safety investments such as the provision of new facilities or the remodelling of existing facilities. The issues of skid resistance, macrotexture, roughness, rutting, drainage, edge wear, edge drop, unsealed shoulder condition, line marking, guide posts, retro-reflective pavement markers, signs, street lighting, and roadside vegetation have been included in this part of the project, and models are currently being developed for each.

2.8 Crash risk migration

This part of the project is intended to build an understanding of the potential for Crash Risk Migration (CRM) to occur with a range of road safety improvement treatments. The current focus is on situations where CRM may occur as a result of traffic redistribution. Some studies appear to show that CRM may occur due to traffic redistribution, and areas for further research to examine this in detail have been identified, including for the installation of overtaking lanes, traffic calming measures and mid-block turning provisions. Until such research is conducted, current approaches to road safety risk evaluation should simply flag relevant issues in such a way as to alert practitioners that secondary effects such as CRM may occur.

3 Recent and future research

Along with the this program of research, work has recently commenced on a new range of projects, some of which are a follow-on from previous work. Work continues on improving our knowledge of the relative risk of various road safety related engineering issues in differing road environments and identify road design elements that affect road safety. Work continues on the database for crash treatment effectiveness, with collection of data from local authorities on the types of safety treatments used, and the effectiveness of these treatments to commence shortly. Finally, work continues on development of baseline crash rates and to consolidate current data into a representative dataset that can be used across all jurisdictions.

In addition, new areas of research have commenced, including research on the interaction effects of two or more road safety interventions (exploring the effect that implementing more than one safety treatment at a site may have), risk relating to specific crash types (for instance run-off-road crashes), and for crashes involving specific vehicles (including heavy vehicles). Finally, work is being undertaken on run-off-road crashes to help identify a comprehensive suite of effective remedial treatments.

In future years, a number of research additional projects are planned in this area. These include continual updating of risk reduction factors based on recent research. It is also intended to explore the automated capture of road and roadside data using digital imagery, Gipsi-Trac (in-vehicle technology used to collect information on road geometry) and laser profilers (used to collect information on road surface condition), and along with this to explore the automatic assignment of risk values based on this data capture. Further work is also planned on broadening the use of base data that has been collected as part of the research program, including network approaches to risk management, or an appropriate tool for planners.

4 Dissemination

As well as dissemination of results through reports and at conferences, ARRB will also be producing a series of newsletters titled the ‘Risk Reporter’. The first of these has now been produced, and outlines the overall research program. As further stages of work are completed, research findings will be summarised and presented in these newsletters in an easily accessible format for use by practitioners. The newsletters will also contain links to full reports where appropriate so that interested readers can seek further details if required. Copies of newsletters can be found on the ARRB website at www.arrb.com.au.

The results of the research program will also used to update the Road Safety Risk Manager (RSRM) software. The RSRM expert system was launched in 2002 to provide authorities with a tool to manage, prioritise and track the status of road safety treatments on their networks. The software allows the assessment and comparison of over 60 different road safety treatments including duplication of a highway, intersection upgrades, guardrail and other roadside treatments, signage, delineation and many other features. RSRM is being used by road authorities for:

- blackspot program prioritisation
- review of construction and high-cost design options
- review of road safety audit recommendations
- prioritisation of public feedback on road engineering issues
- development of road safety works programs.

The models incorporated in the software continue to be updated as part of the research program and this objective forms an important component of the ongoing research.

In addition, ARRB (on behalf of Austroads) is producing the Road Safety Engineering Toolkit, and information from this research program will be used in development of this. The Toolkit is a reference tool for road safety engineering practitioners of best-practice, low cost, high return road environment measures to achieve road safety targets.

5 Summary

ARRB is involved in an ongoing series of Austroads funded research projects on road safety engineering risk assessment. Results from this research will be disseminated through reports, as well as a newsletter, the Risk Reporter. The results will also be made available to practitioners through the Road Safety Risk Manager software, and the Road Safety Engineering Toolkit, which is currently being developed.